REPORT

OF THE

BOMBAY BACTERIOLOGICAL LABORATORY

FOR THE YEAR 1919

BY

Lieut.-Colonel W. GLEN LISTON, C.I.E., M.D., D.P.H., I.M.S.,
Director, Bombay Bacteriological Laboratory.

BOMBAY
PRINTED AT THE GOVERNMENT CENTRAL PRES
1920.

[*Price—3 annas.*]

OFFICIAL AGENTS FOR THE SALE OF INDIAN OFFICIAL PUBLICATIONS.

IN ENGLAND.

CONSTABLE & Co., 10, Orange Street, Leicester Square, W. C., London.

GRINDLAY & Co., 54, Parliament Street, S. W., London.

HENRY S. KING & Co., 65, Cornhill, E. C., London.

P. S. KING & SON, 2 & 4, Great Smith Street, Westminster, S. W., London.

KEGAN PAUL, TRENCH, TRUBNER & Co., Ltd., 68-74, Carter Lane, E. C., and 25, Museum Street, W. C., London.

B. QUARITCH, 11, Grafton Street, New Bond Street, W., London.

W. THACKER & Co., 2, Creed Lane, London, E. C.

LUZAC & Co., 46, Great Russel Street, London, W. C.

B. H. BLACKWELL, 50 & 51, Broad Street, Oxford.

DEIGHTON BELL & Co., Limited, Cambridge.

T. FISHER UNWIN, Limited, 1, Adelphi Terrace, London, W. C.

ON THE CONTINENT.

ERNEST LEROUX, 28, Rue Bonaparte, Paris.

MARTINUS NI

BOMBAY BRANCH
OF THE
Royal Asiatic Society.

HIGGINBOTHA

V. KALYANA

P. R. RAMA I

THACKER, SP

W. NEWMAN

S. K. LAHIRI

R. CAMBRAY & Co., Calcutta.

THACKER & Co., Limited, Bombay.

SUPERINTENDENT, GOVERNMENT PRINTING, BOMBAY, Poona.

D. B. TARAPOREVALA, SONS & Co., Bombay.

GOPAL NARAYEN & Co., Booksellers, etc., Bombay.

Mrs. RADHABAI ATMARAM SAGOON, Bookseller, etc., Bombay.

RAMCHANDRA GOVIND & SON, Booksellers, etc., Bombay.

BOMBAY TRACT AND BOOK SOCIETY, Bombay.

N. B. MATHUR, N. K. H. Press, Allahabad.

MANAGER, NYAYASHRAYA PRESS, Poona.

RAMA KRISHNA & SONS, Lahore.

SUNDAR PANDURANG (RAMNATH SUNDAR, the Successor), Bombay.

THE PROPRIETOR OF THE NEW KITABKHANA, Poona.

KARSANDAS NARANDAS & SONS, Surat.

N. M. TRIPATHI & Co., Bombay.

MUNSHI SEETA RAM, Managing Proprietors, Indian Army Book Depot, Tuhi, Cawnpore.

Digitized with financial assistance from the Government of Maharashtra on 11 July, 2017

CONTENTS.

	Page.
Staff	1
Arrangement of the Report	1

PART I.

Output, in doses, of anti-plague vaccine for the past five years	1
Distribution of anti-plague vaccine	2
Statistics of inoculation	2
Examination of rats for plague	5
Educational work in connection with plague	6

PART II.

Examination of pathological fluids and discharges, water and food-stuffs, etc. ...	7
Classification of morbid tissues sent for examination	7
Diagnosis of rabies	8
The preparation of vaccines	9
Snakes and anti-venine	9
Research work	9
Influenza	9
Miscellaneous assistance rendered	11
Assistance rendered to the Military Authorities	12
Disinfection by means of hydrocyanic acid gas	12
The Parel Enteric Depôt	13
Educational work	14

REPORT OF THE BOMBAY BACTERIOLOGICAL LABORATORY FOR THE YEAR 1919.

Staff.

Staff.

1. This report deals with the work carried out at the Laboratory during the year 1919. Lieut.-Colonel W. Glen Liston, C.I.E., M.D., D.P.H., I.M.S., was Director of the Laboratory from 1st January to 8th March 1919, but when he was on combined leave and deputation to England Major J. C. G. Kunhardt, I.M.S., acted as Director from 9th March to 31st December 1919.

The Director was assisted by the following officers :—

(1) Dr. D. A. Turkhud, M.B., C.M. (Edin.).

(2) „ S. N. Gore, L.M. & S.

(3) „ M. B. Soparkar, M.D. (Bombay).

Arrangement of the Report.

Arrangement of the Report.

2. The report has been divided as usual into two parts dealing with the work done under separate heads :

(*i*) as the Laboratory where all the anti-plague vaccine used in India and its dependencies is made, and where investigations connected with plague are carried out; and

(*ii*) as the Bombay Bacteriological Laboratory where work connected with preventive medicine and pathological diagnosis for the whole of the Bombay Presidency is carried out.

PART I.

Work connected with Plague.

(*a*) Routine Work.

Manufacture and distribution of the Plague Prophylactic.

Output, in doses of anti-plague vaccine for the past five years.

3. The table below gives comparative figures of output, in doses of anti-plague vaccine for the past five years. In these figures the dose of the vaccine is reckoned as 4 c.c., but when used within three months of the date of manufacture, a dose of only 3 c.c. is recommended :—

1915	1916	1917	1918	1919
827,942	1,404,003	1,821,661	1,543,099	1,011,175

From the opening of the Laboratory in 1896 up to the end of the year, 18,850,141 doses of the vaccine have been sent out.

Distribution of anti-plague vaccine.

The distribution of anti-plague vaccine in India and Foreign Countries during the last two years is shown below :—

(Figures represent the number of doses.)

Place or Province.	1918	1919
Bombay Presidency and Sind ...	185,277	85,265
Madras Presidency ...	125,205	66,025
Bengal, Behar and Assam ...	13,440	9,270
United Provinces of Agra and Oudh ...	178,415	45,480
The Punjab ...	223,277	74,160
North-Western Frontier Province ...	13,403	6,320
Central Provinces and Berar ...	52,609	67,840
Burma ...	103,457	65,250
Native States in India ...	382,016	144,845
Countries outside India ...	265,373	446,300
Portuguese Territory in India ...	627	420
Total number of doses ...	1,543,099	1,011,175

The following table shows the number of doses of anti-plague vaccine despatched monthly during the past two years :—

Month.	1918	1919
January	202,397	54,790
February	232,275	80,615
March	197,532	107,630
April	132,000	77,355
May	48,785	118,805
June	44,340	13,315
July	41,200	9,730
August	130,275	38,490
September	202,300	74,095
October	134,700	177,210
November	53,350	99,830
December	123,945	159,310
Total ...	1,543,099	1,011,175

Statistics of Inoculation.

4. The following extracts from a report by Major J. Taylor, D.S.O., M.D., D.P.H., I. M. S., Medical Officer of Health in Baghdad, are interesting :—

"The plague epidemic in Baghdad in 1919 afforded an opportunity of testing the efficacy of anti-plague inoculation on a large scale under conditions of control which, with the organisation at our disposal, was capable of furnishing figures of good statistical value."

"The 18th January may be considered to be the commencement of the plague epidemic for purposes of statistical study. From this date onwards plague progressed regularly, attaining its height in the end of May and terminating, except for one or two dropping cases, in the first week of July." The total number of cases was 871 with 674 deaths.

"Anti-plague inoculation was commenced in Baghdad East on 19th January 1919, and in addition to the original 5,540 inoculations done in December 1918, a further 51,457 were done between that date and 12th May, bringing the total inoculated up to 56,997 in Baghdad East."

"In Baghdad West inoculation was carried on between 15th March and 30th May; 25,561 inoculations in all being done representing 73 per cent. of the population."

"The total thus inoculated in the whole city reached 82,558 or about 50 per cent. of the population."

"The progress of inoculation in the city week by week is shown in Table 1.

"In every case when inoculation was done a certificate of inculation was issued to the individual. These certificates were greatly prized and were kept carefully. On enquiring into any case of plague or any death it was possible to obtain the certificate and to confirm the inoculation and its date."

"Table No. 2 shows the number of attacks and deaths each week among the inoculated and uninoculated in the city.

"TABLE No. I.

Weekly inoculated and uninoculated population.

Week ending	Baghdad East.		Baghdad West.		Whole City.	
	Inoculated & uninoculated Population.		Inoculated Population.	Uninoculated Population.	Inoculated Population.	Uninoculated Population.
24th January ...	7,985	1,21,815	.....	.....	7,985	1,57,015
31st ,, ...	16,115	1,13,685	.....	.....	16,115	1,48,885
7th February ...	20,595	10,205	.....	.....	20,595	1,44,405
14th ,, ...	23,239	1,06,561	.....	.....	23,239	1,41,761
21st ,, ...	27,156	1,02,644	.....	.....	27,156	1,37,844
28th ,, ...	29,512	1,00,288	.....	.....	29,512	1,35,488
7th March ...	31,795	98,005	.....	.....	31,795	1,33,205
14th ,, ...	34,095	95,705	.....	.....	34,095	1,30,905
21st ,, ...	34,095	95,705	4,681	30,519	38,776	1,26,224
28th ,, ...	38,659	91,141	9,043	26,157	47,702	1,17,298
4th April ...	44,561	85,239	12,766	22,434	57,327	1,07,673
11th ,, ...	47,930	81,870	16,374	18,826	64,304	1,00,696
18th ,, ...	50,849	78,951	18,059	17,141	68,908	96,092
25th ,, ...	52,159	77,641	21,108	14,092	73,267	91,733
2nd May ...	54,720	75,080	22,489	12,713	77,209	87,793
9th ,, ...	56,641	73,159	24,075	11,125	80,716	84,284
16th ,, ...	56,997	72,803	24,481	10,719	81,478	83,522
23rd ,, ...	56,997	72,803	24,808	10,392	81,805	83,195
30th ,, ...	56,997	72,803	25,561	9,639	82,558	82,442
6th June ...	56,997	72,803	25,561	9,639	82,558	82,442
13th ,, ...	56,997	72,803	25,561	9,639	82,558	82,442
20th ,, ...	56,997	72,803	25,561	9,639	82,558	82,442
27th ,, ...	56,997	72,803	25,561	9,639	82,558	82,442
4th July ...	56,997	72,803	25,561	9,639	82,558	82,442
Totals ...	10,26,022	20,89,113	3,31,250	2,31,952	13,57,332	26,02,670
Averages ...	42,752	87,048	20,703	14,497	56,555	1,08,445

"TABLE No. 2.

Weekly Plague Cases and Deaths.

Week ending	Baghdad East.						Baghdad West.						Whole City.				
	Total cases.	Total deaths.	Uninoculated cases.	Uninoculated deaths.	Inoculated cases.	Inoculated deaths.	Total cases.	Total deaths.	Uninoculated cases.	Uninoculated deaths.	Inoculated cases.	Inoculated deaths.	Total cases.	Total deaths.	Uninoculated cases.	Uninoculated deaths.	Inoculated cases.
24th January ...	5	2	5	2	...	...	...	...	...	...	...	...	5	2	5	2	...
31st " ...	3	3	3	3	...	...	...	...	...	...	...	...	3	3	3	3	...
7th February ...	2	1	1	1	1	...	...	...	...	...	...	...	2	1	1	1	1
14th " ...	8	6	7	6	1	...	...	...	...	...	...	...	8	6	7	6	1
21st " ...	13	7	13	7	...	...	...	...	...	...	...	...	13	7	13	7	...
28th " ...	6	5	6	5	...	...	...	...	...	...	...	...	6	5	6	5	...
7th March ...	12	11	11	10	1	1	...	...	...	...	...	...	12	11	11	10	1
14th " ...	14	11	13	11	1	...	4	4	4	4	...	...	18	15	17	15	1
21st " ...	17	12	16	11	1	1	5	4	5	4	...	...	22	16	21	15	1
28th " ...	33	20	31	19	2	1	11	9	11	9	...	...	44	29	42	28	2
4th April ...	32	26	32	26	...	...	10	8	9	8	1	...	42	34	41	34	1
11th " ...	44	28	37	24	7	4	8	7	8	7	...	...	52	35	45	31	7
18th " ...	43	33	43	33	...	...	15	14	12	11	3	3	58	47	55	44	3
25th " ...	47	28	40	25	7	3	13	13	12	12	1	1	60	41	52	37	8
2nd May ...	50	31	44	28	6	3	35	29	31	27	4	2	85	60	75	55	10
9th " ...	40	26	37	25	3	1	22	22	22	22	...	...	62	48	59	47	3
16th " ...	37	28	33	26	4	2	24	23	22	21	2	2	61	51	55	47	6
23rd " ...	38	31	34	29	4	2	44	42	39	37	5	5	82	73	73	66	9
30th " ...	66	50	64	49	2	1	28	25	27	24	1	1	94	75	91	73	3
6th June ...	40	32	38	31	2	1	10	9	10	9	...	...	50	41	48	40	2
13th " ...	29	23	28	23	1	...	11	10	11	10	...	...	40	33	39	33	1
20th " ...	27	20	23	18	4	2	3	2	3	2	...	...	30	22	26	20	4
27th " ...	13	12	12	12	1	...	...	...	...	...	...	...	13	12	12	12	1
4th July ...	9	7	9	7	...	...	...	...	...	...	...	...	9	7	9	7	...
Totals ...	628	453	580	431	48	22	243	221	226	207	17	14	871	674	806	638	65

"By the end of May the whole town was infected and in the week ending 30th May, we had almost exactly equal inoculated and uninoculated populations. With these equal populations and equal exposure to infection from this time onwards no calculations are necessary and the crude figures of cases and deaths in the two classes can be compared directly."

"The cases and deaths for week ending 30th May (inclusive) to the end of the epidemic were :—

Inoculated cases	11
" deaths	5
Uninoculated cases	225
" deaths	185

"The protection is thus shown as 22 times against attack and 46 times against death."

"No stronger evidence of the value of inoculation is required."

"With such a degree of protection an epidemic which would produce 1,000 deaths would be reduced to 22 deaths by inoculation."

It should be noted however that while the number of inoculated and uninoculated were almost equal on the 30th May, if the whole city is taken into consideration ; yet the proportion of the inoculated to the uninoculated was much greater in Baghdad West than in Baghdad East. Now the plague prevailed more severely in Baghdad East than in Baghdad West, so that when the whole city is considered, the inoculated were placed in a relatively favourable position to the uninoculated.

It will be observed that inoculation ceased to be practised in Baghdad East from the week ending 16th May. At that time the proportion of inoculated to uninoculated in this part of the city was 56,997 to 72,803 and if the number of attacks and deaths from plague after and including this week are added up, we find that the inoculated had eighteen attacks and eight deaths while the uninoculated had 241 attacks and 195 deaths. These figures give an attack rate of 33 per ten thousand among the uninoculated and three per ten thousand among the inoculated. The death rate per ten thousand uninoculated for this period is 26·8, while among the inoculated, it was only 1·3. Taken at its lowest value, it is evident that inoculation materially reduced the number of attacks and deaths in the severe outbreak of plague, which occurred in Baghdad in the spring of 1919.

(*b*) Research.

5. No important research in connection with plague was undertaken during the year, the whole energy of the staff being devoted to the study of Influenza and the preparation of influenza vaccine.

(*c*) Assistance and Advice rendered.

Examination of rats for plague.

6. The Health Department of the City of Bombay continued to send to this Laboratory rats found dead or caught alive within the municipal limits. With each rat a note was received indicating where it had been caught or found, so that after examination it was possible to inform the Health Officer, where plague-infected specimens had been picked up. The Health Officer was thus able to deal effectively with the progress of the disease in the different parts of the city.

During the year 1919, seven hundred and seventy-eight thousand six hundred and forty-one rats were received at the Laboratory. Of this number two hundred and thirty-four thousand two hundred and ninety-three were alive when received, and five hundred and forty-four thousand three hundred and forty-eight were dead. Of the latter three hundred and ninety-four thousand four hundred and twenty were examined and among them six thousand eight hundred and one were found to be plague-infected.

The following table shows the progress of plague among men and rats in Bombay City during each half month of the year 1919. The figures which refer to human mortality record the number of deaths from plague each half month. The figures showing the progress of the disease in rats are given separately for Mus rattuss and Mus decumanus. These figures have been calculated from the number of rats found infected at the examination made at the Laboratory on every day of the week except Sundays and holidays; from the actual figures thus obtained a figure has been calculated for all the days of each half month and these are the figures recorded below:—

Return of rats examined during the year 1919.

	Human Plague mortality.		Plague-infected Mus rattus.		Plague-infected Mus decumanus.	
	Number of deaths from Plague.	Percentage above or below mean for the year.	Figures calculated for each half month.	Percentage above or below mean for the year.	Figures calculated for each half month.	Percentage above or below mean for the year.
1st to 15th January ...	2	—93	1·2	—97	67·5	—78
16th to 31st „ ...	3	—89	9·1	—80	74·3	—76
1st to 15th February ...	3	—89	13·8	—69	118·8	—61
16th to 28th „ ...	7	—74	22·1	—51	128·7	—58
1st to 15th March ...	31	+15	26·5	—41	407·3	+32
16th to 31st „ ...	68	+152	90·2	+100	750·5	+144
1st to 15th April ...	97	+259	221·2	+390	1,100·0	+257
16th to 30th „ ...	141	+422	187·5	+316	1,251·2	+306
1st to 15th May ...	130	+381	150·0	+233	993·5	+222
16th to 31st „ ...	74	+174	84·6	+88	696·0	+126
1st to 15th June ...	23	—15	36·8	—18	349·1	+13
16th to 30th „ ...	13	—52	46·4	+3	271·4	—12
1st to 15th July ...	10	—63	69·2	+53	225·0	—27
16th to 31st „ ...	7	—74	20·9	—54	146·5	—52
1st to 15th August ...	6	—78	15·0	—67	143·7	—53
16th to 31st „ ...	11	—59	18·9	—58	152·7	—50
1st to 15th September ...	3	—89	16·4	—64	84·5	—73
16th to 30th „ ...	4	—85	8·7	—81	76·2	—75
1st to 15th October ...	3	—89	5·0	—89	72·5	—76
16th to 31st „ ...	2	—93	7·4	—84	56·6	—82
1st to 15th November ...	1	—96	6·9	—85	39·2	—87
16th to 30th „ ...	2	—93	10·0	—78	56·2	—82
1st to 15th December ...	1	—96	6·8	—85	60·0	—81
16th to 31st „ ...	1	—96	8·7	—81	72·7	—76
Total ...	643					

(*d*) Educational Work.

7. (1) During the year six medical men attended the Laboratory for a course of instructions in the technique of inoculation.

(2) Four medical men and two medical ladies underwent a course of practical training in Bacteriology at the Laboratory.

(3) An Assistant Superintendent in the Vaccine Institute, Belgaum, was taught section cutting, etc.

PART II.

Work of the Laboratory as the Provincial Bacteriological Laboratory.

(*a*) Routine Work.

I.—Examination of pathological fluids and discharges, water, food-stuffs, etc.

Examination of pathological fluids and discharges, water and food-stuffs.

8. (1) Blood sera for agglutination for typhoid, paratyphoid and Malta fevers, etc. ... 113 specimens.

(2)	Blood for Wassermann reaction	1310	„
(3)	Blood smears examined ... ... 106 Blood counts made 3	= 109	„
(4)	Sputa for B. tuberculosis or other organisms ...	77	„
(5)	Throat swabs for diptheriae, meningococcus, pneumococcus, etc.	154	„
(6)	Urine and faeces—		
	Urine for general examination tuberculosis, cholera, Bilharziosis, etc.	86	„
	Faeces for cholera, dysentery, typhoid, etc. ...	488	„
(7)	Smears of pus for gnococci, meningococcus, etc. ...	69	„
(8)	Fluids and discharges	15	„
(9)	Cultures of organisms for identification ...	11	„
(10)	Smears from rats for the presence of bacillus pestis.	20	„
(11)	Specimens examined for the presence of leprosy bacilli	6	„
(12)	Milk—samples of dairy milk	90	„
(13)	Water—		
	Chemical examination ... 213 Bacteriological examination ... 179	= 392	„
(14)	Food-stuffs examined or analysed	8	„
(15)	Miscellaneous examinations of soap, air, spirit, sodium carbonate	7	„
(16)	Brushes examined for anthrax	53	„
(17)	Test tubes tested for sterility	4	„
(18)	Disinfectants tested	3	„
(19)	Post-mortem examinations carried out on animals received from the Victoria Gardens ...	17	„
(20)	Fleas, fly and snakes for identification ...	5	„

II.—Pathological tissues for diagnosis.

Classification of morbid tissues sent for examination.

9. I.—Tumours—

A.—Non-malignant.

Fibroma	3
Cystic Fibroma	2
Fibro adenoma	1
Cystic adenoma	1
Fibro Cystic adenoma	3
Papillary adenoma	1
Fibro angioma	1
Glioma	1
Lipoma	1
Fibro Lipoma	1
Fibro Lymphangioma	1
Myxoma	2
Papilloma	3
Fibro myoma-uterus...	1
Myxo chondroma	1
	23

B.—Malignant.

Carcinoma	... 14
Adeno carcinoma	... 1
Melanotic carcinoma...	... 1
Glandular carcinoma	... 3
Epithelioma	... 13
Endothelioma	... 3
Round celled sarcoma	... 5
Melanotic sarcoma	... 2
Alveolar sarcoma	... 1
Spindle celled sarcoma	... 3
Chondro sarcoma	... 1
Degenerated sarcoma	... 2
	49

II.—Granulomata—

Tubercular	... 10
Other granulomata	... 6
	16

III.—Other Pathological conditions—

Inflammatory condition	... 3
Congestion of heart	... 1
Cysts of different varieties	... 3
Chronic fibrosis	... 1
Leprosy (nodule)	... 1
Molluscum contagiosum	... 1
Nutmeg liver	... 1
Piles	... 1
Hodgkin's disease	... 2
Perisplenitis	... 1
Pneumonic lung	... 5
Tissues found to be normal	... 1
No definite diagnosis	... 7
Tissues found to be non-malignant	... 18
Miscellaneous Pathological conditions	... 48
	94
Total	... 182

III.—Diagnosis of Rabies.

Examination of dogs, etc., for rabies.

10. The following is the statement of the examination of brains of dogs and other animals for the diagnosis of rabies during the year 1919.

Bombay—

Through the Bombay Veterinary College	51
Through the Bombay Police	35
Through the Bombay Municipality	1
Through Private owners	7
From other places in Bombay	6
Outstations	48
	148

The result of the examination of these brains was as follows.—

Received in a condition unfit for examination	8
No evidence of rabies	30
Suspicious although no definite Negri bodies found	15
Negri bodies found, brains obtained from rabid animals ...	95
	148

IV.—The preparation of vaccines.

Vaccines.

11. In addition to the plague vaccine, details of which are recorded elsewhere, the following vaccines were prepared at the Laboratory and supplied both to military and other bodies in and out of India.

Autogenous vaccines prepared for 101 cases.

Stock vaccines—

Staphylococcus	58 doses.
Streptococcus	30 „
Gonococcus	65 „
B. acne	540 „
Tuberculin	159 „
Pneumococcus	54 „
Anti-cholera	37,525 „
Mixed T. A. B.	164,965 doses.
Leprosy	2,630 c.c.s.
Influenza	50,750 doses.

V.—Snakes and anti-venine.

Snakes.

12. The following poisonous snakes were received alive at the Laboratory. Venom was collected periodically from the cobras and Russell's Vipers. It was dried and sent to the Central Research Institute, Kasauli, where the anti-venine is prepared.

Place.	Cobras.	Russell's Vipers.	Krait.	Echis.
Bharatpur ...	5	...	...	...
Bhagalkot ...	3	...	...	...
Ranebennur ...	1	...	...	...
Bombay ...	4	11	...	...
	13	11	...	...

Total number of snakes received alive 24

(*b*) Research Work.

Influenza.

13. The attention of the workers in the laboratory was for the most part devoted to researches in connection with Influenza.

The Director prepared a report on the work which had been done up till the time of his departure on leave to England. In this report he gave some details of the prevalence of Influenza in Bombay City and drew attention to two important points:—

(1) The disease prevailed in the city during two epidemic periods, one period of about a month extended from the middle of June to the middle of July, during this period it had been estimated that close on 300,000 people suffered from the disease. A second period extended from the beginning of September to the middle of November, when even a larger number of persons were affected.

(2) The second epidemic came to an end about the middle of November after a large proportion of the inhabitants of the city had been attacked

and in spite of the fact that many fresh cases of the disease were imported into the city, or occurred among persons who had recently come to the city. Few persons suffered from the disease during both the first and second epidemic, indeed it was notorious that persons who were attacked during the first epidemic escaped infection during the second epidemic, and that those who suffered from the disease in the second epidemic had not been attacked during the first epidemic. These facts suggested that one attack of influenza confers some immunity against a second attack.

Additional support was lent to this view by the experience of the disease in the Labour Corps Camps and Hospital at Dadar. Connected with the camps and hospital there is a large permanent staff while there is also a still larger floating population. Coolies are brought into the camps from all parts of India preparatory to their departure overseas and a certain number of men from overseas come to the camps and hospital preparatory to their return to their homes in India. These conditions afforded very frequent opportunities for the importation of infection into the camps and hospital, subjecting again and again, the permanent residents in the camps and hospital to chances of infection. In spite of the fact that cases of influenza were frequently admitted to Hospital among persons who had recently come to the camps during November and December, no cases of the disease occurred among the permanent staff.

This experience he pointed out was at complete variance with the statement made by the Influenza Committee of the Advisory Board to the Director General, Medical Services, France, published on page 509 of the British Medical Journal, dated 9th November 1918, to the effect "It is common experience that an attack of influenza leaves little or no immunity. Indeed it is the opinion of many physicians that one attack predisposes to another." He suggested that statements of this kind were based on incorrect diagnosis and he proceeded to describe how varied were the views held by physicians regarding the nature of the disease when it first appeared in the city; as the existence of the disease in the city became more widely known any disease, not easily recognised, might be diagnosed as influenza.

The influenza bacillus itself is not easily demonstrated in every case of influenza; this may be due to the restriction of the organism to some inaccessible part of the body, but it might also be due to the crowding out of the influenza bacillus by the growth of other micro-organisms such as pneumococci and streptococci. This illusion is intensified when cultures are made for, while pneumococci and streptococci readily grow on the culture media commonly used, the influenza bacillus seldom survives on these media. The attention of the workers in the laboratory was therefore early directed to the preparation of a suitable medium for the cultivation of the influenza baccilus, first in order to make a study of the various strains isolated and secondly to obtain suitable cultures for the preparation of a vaccine. We had found that even on blood agar the influenza bacillus died out on repeated subculture. In this respect our experience was again at variance with the following statement made in the Report on the Influenza epidemic in the British Armies in France, published on page 507 of the British Medical Journal, issued on the 9th November 1918: "On subculture upon blood agar they grew well, the colonies increasing in size with successive subculture until in the case of some strains they attained the diameter of 0·5 to 1 m.m., after twenty-four hours' incubation."

Many different kinds of media were tried till towards the close of the second epidemic a medium was found by Dr. Soparkar, one of the workers in the laboratory, on which the influenza bacillus grew readily.

This medium consists of ordinary nutrient agar mixed with a preparation of human blood. The nutrient agar is prepared according to the following formula:—

Meat extract	... ...	1 litre.
Peptone	... ...	20 grammes.
Sodium chloride	... ...	5 „
Agar	... ...	30 „

The medium is rendered slightly alkaline to litmus by the addition of sodium carbonate. The meat extract is prepared by boiling 1 kilogramme of meat with 2 litres of water for 40 minutes. It is then filtered and sterilized in the autoclave at 15 lbs. pressure. The kind of peptone used is of importance; one prepared in the Laboratory by digesting casein with pancreatic extract gave good results but Fairchild's peptone is also suitable.

The human blood which is added to the nutrient agar was treated as follows :—

One volume of freshly drawn human blood is added to a flask containing four volumes of sterile citrated saline (0·5 per cent. sod. cit. and 0·85 per cent sod. chlor.). The blood and saline are thoroughly mixed by shaking and the fluid is then heated in a water bath at 66° C. for 30 minutes. The heating causes the formation of a fine brown precipitate which is removed by filtration through sterilised filter paper. The filtrate is a clear deep red fluid and must be collected with strict aseptic precautions. One cubic centimetre of this fluid is added to ten cubic centimetres of melted agar at 50 °C.. After mixing the tubes are sloped and allowed to set. The medium is clear and transparent of a golden brown colour. The influenza bacillus grows well upon it; an emulsion prepared from a twenty-four hour old culture planted on an ordinary sized agar slopes yields from 12 to 15 thousand million organisms. Human blood must be used; the blood of other animals when treated in the same way and added to agar did not give as good results.

Using this medium a vaccine was prepared which contained 250 millions bacilli in 0·5 c. c. This vaccine was found to cause very little reaction when injected subcutaneously in men, and the Director hoped that an opportunity to test this vaccine on scientific principles would occur during his absence on leave in England. Acting under the orders of the Government of India, however, the Acting Director was instructed to prepare and issue a mixed vaccine containing 60 millions influenza bacilli and 200 millions pneumococci per c. c. This vaccine has been used in certain epidemics of influenza where careful observations were made on inoculated and uninoculated. An examination of these epidemics and the effect of the vaccine on them has yielded conflicting results. Unfortunately the observations have shed no light on the all important question—what organism is the cause of influenza? Is the influenza bacillus the cause of the disease? Certain officers have now been placed on special duty under the Research Fund Association and it is hoped that this important question will receive their careful attention.

(*c*) Assistance and Advice rendered.

On proceeding on leave to England on the 8th March 1919, Lieutenant-Colonel W. G. Liston, Director of the Laboratory, was relieved of his honorary duties as Consulting Bacteriologist to the War Hospitals in Bombay. The Enteric Depôt which had been accommodated in the laboratory building was closed on the 28th of February 1919.

It seems fitting here to place on record a brief account of the work which was done in the Bombay Bacteriological Laboratory during the war.

Shortly after the outbreak of the war the officer in charge of Medical Stores, Bombay, found it increasingly difficult to meet the abnormal demands made upon him for equipment of different kinds. Early in the year 1915, he appealed to the Laboratory to help him by making glass bulbs containing a mixture of iodine and potassium iodide. These capsules were required for the preparation of antiseptic lotion and formed a part of the field hospital equipment. The officer in charge of the Medical Stores assured us that he was not able to obtain these bulbs from England nor could he get them made by firms in India. In these circumstances we undertook this somewhat unusual work and after some trials succeeded in preparing satisfactory samples. In a short time we were able to supply 14,108 bulbs containing a mixture of powdered iodine and potassium iodide suitable for making antiseptic lotion.

A little later the Medical Storekeeper found that he was unable to secure a supply of special glass bulbs containing tincture of iodine. These bulbs are supplied with each field shell dressing. He therefore again appealed to us for help and we were able to prepare 48,000 of these bulbs for him in a short time. After this experience the Medical Storekeeper to Government frequently sought the assistance of the Laboratory staff for example in testing such special drugs as emetine hydrochloride, sulphonal, kharsivan and similar preparations; in estimating the efficiency of a great variety of disinfectants and insecticides; in examining field dressings for sterility and for the presence of antiseptics; in testing patent foods such as panopeptone, etc. We were also asked to make and supply taurocholate of soda. We were able to produce this preparation at a considerably lower cost than the prevailing market rate in India at the time. We are at present engaged in carrying out experiments which we hope will enable us to supply peptone on a large scale and at much cheaper rates than this substance can be purchased in Europe.

During the hot weather of 1916, a large number of troops sick and wounded arrived in Bombay from Mesopotamia. A number of new hospitals were opened in buildings which were under construction but which had not yet been occupied such as the Gerard Freeman Thomas War Hospital, The Victoria War Hospital, The Lady Hardinge War Hospital, The Alexandra War Hospital, The Cumballa War Hospital. Equipment and staff for the bacteriological and pathological work of these hospitals were required. The Director of the Laboratory endeavoured to help Major Davys, the Officer at that time in charge of the Bacteriological work of the War Hospitals in Bombay, by supplying him with such material, equipment and trained staff as could be spared. The number of sick arriving in Bombay however increased so rapidly and Major Davys' requirements were so numerous that the simplest solution of the difficulties in which the military medical authorities found themselves in regard to bacteriological and pathological examinations seemed to lie in the Bombay Bacteriological Laboratory taking over the whole responsibility for this work. This scheme promised to be economical in respect to equipment, supplies of which in India at the time were very limited, and the scheme became practically necessary because a sufficient number of trained medical officers on military duty could not be found to undertake the skilled work required.

Orders were issued in telegram No. 12331/3. D.M.S.I., dated 12th June 1916, that the Director of the Bombay Bacteriological Laboratory should be responsible for the supervision of the whole of the bacteriological work connected with the war hospitals in Bombay. The Bombay Government agreed to the co-operation of the Laboratory in this work and the Director took over the duties from Major Davys on the 22nd June 1916.

The work which has been accomplished in connection with the war hospitals has been communicated to the A. D. M. S., Bombay Brigade, to the Surgeon-General and to the Director-General, Indian Medical Service, in a series of half-yearly and yearly reports. The number of specimens of different kinds examined at the Bombay Bacteriological Laboratory for the military department during the war amounted to more than 200,000. In addition to the examinations of these specimens other work was undertaken by the Laboratory such as the fumigation of hospitals and kit in Bombay and Deolali to kill vermin. A special plant for this purpose was designed and erected at the Alexandra Docks. Plans for the similar plants were supplied to the Colonial Office, East Africa and Karachi. All the Laboratories attached to the war hospitals were equipped by the Bombay Bacteriological Laboratory. Milk, water, foodstuffs were examined for all military institutions. Assistance was given to the D. A. D. M. S. Sanitary, Bombay Brigade, in studying outbreaks of epidemic diseases such as Cholera, Plague, Iufluenza, Seven days' fever, etc. A number of medical officers in charge of laboratories in India and overseas sent cultures for identification. These were carefully examined and reported upon.

In addition to the work mentioned above the Laboratory prepared and supplied during the war bacterial vaccines of different kinds to the troops in India and abroad amounting in all to nearly two million doses.

About the beginning of July 1916, it became obvious to the responsible authorities in Bombay that the satisfactory working of the military hospitals was being impeded by the necessity to retain in them men who had recovered from enteric fever pending their transfer to an enteric depôt to ascertain whether they were or were not carriers. It was not possible to conduct the necessary bacteriological examinations for this purpose in the hospitals in which the men were detained for very special arrangements are required to carry out the examinations satisfactorily. These examinations are generally made at special convalescent hospitals or camps called Enteric Depôts. In July 1916, there were only 2 Enteric Depôts in India, one at Wellington and another at Naini Tal. Both of these depôts are situated at a very long distance from Bombay and both were at the time more than full. It was under these circumstances that the Director of the Laboratory suggested that the portion of the building in which the Bombay Bacteriological Laboratory is housed which had been prepared for the School of Research in Tropical Medicine might be used with advantage as an Enteric Depôt and he undertook to organise and to take charge of the Depôt in addition to his other duties as Consulting Bacteriologist and Pathologist to the war hospitals and as Director of the Bombay Bacteriological Laboratory.

In July 1916, sanction was obtained to open the Enteric Depôt at Parel. Plans were prepared and after the completion of certain structural alterations the Depôt was ready for occupation on the 14th August 1916. The staff of the Depôt was selected from among the patients who had suffered from enteric fever and who were awaiting examination in the hospitals in Bombay. This staff consisted of a Sergeant-Major, a Quarter-Master-Sergeant, some clerks, cooks and orderlies, amounting in all to 12 men. With the assistance of these patients arrangements were completed. On the 17th August Captain J. A. Cruickshank, I. M. S., was posted to the Depôt for duty, and on the 18th August Assistant Surgeon Lafrenais joined the staff. On the 18th and 19th August 124 patients were admitted making with the twelve already mentioned, a total of 136. By the 14th November 300 patients were present in the Depôt. The Depôt remained open from 17th August 1916 to 28th February 1919, and during this period more than two thousand patients were treated and examined in it. Among these 49 carriers were detected. A careful study of these "Carriers" was made by Captain Cruickshank and Assistant Surgeon Lafrenais; the details of this study are reported in a paper presented by them to the Medical Research Section of the Indian Science Congress held in Bombay on 15th January 1919. An interesting point brought to notice in that paper was the fact that a certain number of men who were carriers for a longer period than three months eventually ceased to be carriers in from six to nine months, so that it is not correct to call such men "chronic carriers". A more correct definition of a chronic carrier is one who excretes bacilli for a period of six months after admission to an Enteric Depôt. This is the classification now adopted in the army. An examination of the 49 carriers detected among the men admitted to this Depôt yielded the results summarised in the table given below:—

Duration of carrying in months from date of commencement of illness.

Duration in months.	3	4	5	6	7	8	9
Total number of cases	5	8	9	8	3	3	1
Number of carriers of B. Typhosus ...	1	1	3	...	...	...	...
Number of carriers of B. Para Typhosus "A".	4	6	3	8	2	2	1
Number of carriers of B. Para Typhosus "B".	...	1	3	...	1	...	...

The remaining 13 carriers were definitely chronic.

The Depôt was a striking success, men discharged from hospital were restored to perfect health in a few weeks and returned to their units fit for duty. This was effected by systematic physical training under medical supervision, and by the encouragement of games in the open air.

Digitized with financial assistance from the Government of Maharashtra on 11 July, 2017

(*d*) EDUCATIONAL.

Special demonstrations were arranged for the Students of the Ratnagiri and Nadiyad High Schools, the Training College for Women, Poona, Secondary Training College, Bombay, and other institutions.

A number of sets of magic lantern slides on Plague, Tuberculosis and Guineaworm diseases were prepared at the Laboratory and issued to the Sanitary Commissioner, Bihar and Orrisa, the District Health Association, Trichinopoly, and Mr. E. A. Ginwala, Ahmedabad.

W. GLEN LISTON, M.D., D.P.H.,
Lt.-Col., I. M. S.,
Director, Bombay Bacteriological Laboratory.

Bombay Bacteriological Laboratory,
Parel, Bombay, 19th May 1920.

BOMBAY : PRINTED AT THE GOVERNMENT CENTRAL PRESS.